

**Remarks**

Claims 1–15 are pending in this application. Claims 1 and 9 are independent; Claims 2–8 depend from Claim 1, and Claims 10–15 depend from Claim 9. The remarks below and the accompanying Declaration of Prior Invention necessitate neither further search nor extensive consideration by the Examiner, and are believed to place the application in condition for allowance. Therefore, their consideration is respectfully requested.

**Claim Rejections Under 35 U.S.C. § 102(e) and 35 U.S.C. § 103.**

Claims 1–3, 9–11 and 15 stand rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent 6,800,830 (“Mahawili”). Claims 4–8 and 12–14 stand rejected as being obvious based on Mahawili in view of one or more of U.S. Patent 6,727,148 (“Setton”), U.S. Patent 6,297,539 (“Ma”) and U.S. Patent 6,744,104 (“Aoki”). Claims 1 and 9 are the only independent claims pending in this application.

Applicants respectfully traverse these rejections on the grounds that Mahawili is not available as prior art against these claims because Applicants invented the claimed subject matter before the effective date of Mahawili.

As expounded in the Declaration of Prior Invention which accompanies this Response, the inventors conceived of the invention disclosed and claimed in the present application before 18 August 2000, which is the earliest priority date to which Mahawili may be entitled. The attached Declaration further states that the inventors worked with due diligence from before the filing date of Mahawili to the constructive reduction to practice of their invention on 24 November 2000 with the filing of U.S. Provisional Patent Application 60/253,693, to which the present application claims priority. Consequently, Mahawili does not qualify as prior art against the present claims and Applicants respectfully request the withdrawal of all rejections based wholly or partially on Mahawili.

Application Number **10/626,217**  
Amendment dated **21 January 2005**  
Reply to Office Action of **17 December 2004**


**Conclusion.**

In view of the foregoing, Applicants submit that this application is in condition for allowance, and respectfully request the same. If, however, some issue remains that the Examiner feels can be addressed by an Examiner's Amendment, the Examiner is cordially invited to call the undersigned for authorization.

Respectfully submitted,

KNOBBE MARTENS OLSON & BEAR LLP

Dated: 21 jan 05

By: 

Kyle F. Schlueter  
Registration No. 54,912  
Attorney of Record  
Customer No. 20,995  
(310) 551-3450

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application Number: 10/626,217                      Confirmation Number: 9650  
Applicant:                      Pomarede, et al.  
Filing Date:                      24 July 2003  
Art Unit:                      2822  
Examiner:                      Christy L. Novacek  
Customer Number:                      20,995

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Commissioner for Patents  
Post Office Box 1450  
Alexandria, Virginia 22313-1450

**DUPLICATE COPY OF EARLIER SUBMISSION**

Sir:

An after-final submission was filed via facsimile in the above-captioned application on 21 January 2005. The submission included a Transmittal Letter with Certificate of Fax Transmission in 1 page, an IDS with PTO/SB/08 in 2 pages, a Response to Final Office Action in 3 pages and an Declaration under 37 C.F.R. § 1.131 with Exhibit in 9 pages. Of these papers, only the Transmittal Letter and IDS with PTO/SB/08 appear to have been entered in the Office's IFW system.

To expedite prosecution of this application, enclosed herewith are the following:


- duplicate copies of the four pages of the prior submission which appear in the Office's IFW system. This includes the Transmittal Letter with Certificate of Fax Transmission signed on 21 January 2005; and
- a duplicate copy of all 16 pages of the prior submission.

Applicant respectfully requests that the enclosed papers be entered into the official file for the above-referenced application. As these papers were timely submitted on 21 January 2005, Applicant respectfully submits that no additional time extension fees are required. However, the Office is hereby authorized to charge any additional fees, including any fees for required time extensions, to Deposit Account 11-1410.

Respectfully submitted,

KNOBBE MARTENS OLSON & BEAR LLP

Dated: 14 apr 05

By:   
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PAGE 1/16 RCVD AT 1/21/2005 5:26:40 PM [Eastern Standard Time] : SVR:USPTO-EFXXRF-1/2 : DNSIS:8729306 : CSID: : DURATION (mm:ss):04:10

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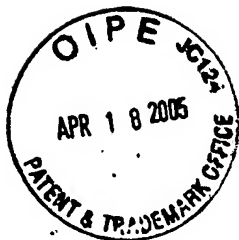
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Applicant : Pomarede, et al.  
App. No. : 10/626,217  
Filed : July 24, 2003  
For : SURFACE PREPARATION  
PRIOR TO DEPOSITION  
Examiner : Christy L. Novacek  
Art Unit : 2822

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*Kyle F. Schlueter*  
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Kyle F. Schlueter, Reg. No. 54,912

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Sir:

Transmitted herewith for filing in the above-identified application are the following enclosures:

- (X) Response to Final Office Action in 3 pages.
- (X) Declaration of Prior Invention in the United States of America to Overcome Cited Patent or Publication with Exhibit A in 9 pages.
- (X) Information Disclosure Statement
- (X) Charge \$180.00 to Deposit Account No. 11-1410 for filing fees for the Information Disclosure Statement.
- (X) Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

*Kyle F. Schlueter*  
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Registration No. 54,912  
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Customer No. 20,995  
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### INFORMATION DISCLOSURE STATEMENT

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Filed : July 24, 2003  
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Examiner : Christy L. Novacek  
Art Unit : 2822

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Alexandria, VA 22313-1450

Dear Sir:

Enclosed for filing in the above-identified application is an Information Disclosure Statement by Applicant (PTO/SB/08 equivalent) listing 2 references to be considered by the Examiner. This Information Disclosure Statement is being filed after the mailing date of a final action or after the mailing date of a Notice of Allowance. This Statement is accompanied by the fee set forth in 37 C.F.R. § 1.17(p). The Commissioner is hereby authorized to charge any additional fees which may be required or to credit any overpayment to Account No. 11-1410.

#### CERTIFICATION UNDER 37 C.F.R. § 1.97(e)(2)

I hereby certify that no item of information contained in this Statement was cited in a communication from a foreign Patent Office in a counterpart foreign application, and, to my knowledge after making reasonable inquiry, was known to any individual designated in 37 C.F.R. § 1.56(c) more than 3 months prior to the filing of this Information Disclosure Statement.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: 21 Jan 05

By: Kyle P. Schluter

Kyle P. Schluter, Registration No. 54,912  
Attorney of Record  
Customer No. 20,995  
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<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (Multiple sheets used when necessary)	Application No.	ASMEX.284DV1
	Filing Date	July 24, 2003
	First Named Inventor	Pomarede, et al.
	Art Unit	2822
	Examiner	Christy L. Novacek
SHEET 1 OF 1	Attorney Docket No.	ASMEX.284DV1

U.S. PATENT DOCUMENTS					
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		6,503,330	1/7/03	Sneh, et al.	
		6,551,399	4/22/03	Sneh, et al.	

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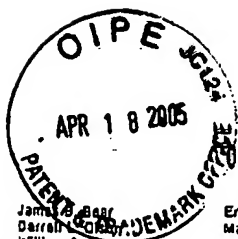
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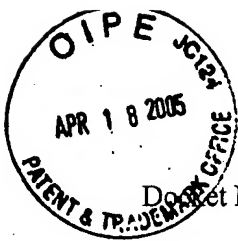
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Document No.: ASMEX.284DV1

Customer No.: 20,995

**AMENDMENT / RESPONSE TRANSMITTAL**

Applicant : Pomarede, et al.  
App. No. : 10/626,217  
Filed : July 24, 2003  
For : SURFACE PREPARATION  
PRIOR TO DEPOSITION  
Examiner : Christy L. Novacek  
Art Unit : 2822

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January 21, 2005

(Date)


  
Kyle F. Schlueter, Reg. No. 54,912

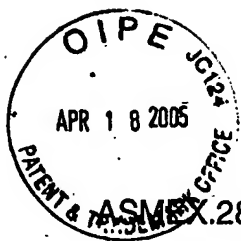
**Mail Stop AF**  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

Transmitted herewith for filing in the above-identified application are the following enclosures:

- (X) Response to Final Office Action in 3 pages.
- (X) Declaration of Prior Invention in the United States of America to Overcome Cited Patent or Publication with Exhibit A in 9 pages.
- (X) Information Disclosure Statement
- (X) Charge \$180.00 to Deposit Account No. 11-1410 for filing fees for the Information Disclosure Statement.
- (X) Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

  
Kyle F. Schlueter  
Registration No. 54,912  
Attorney of Record  
Customer No. 20,995  
(949) 760-0404



PATENT

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Applicant : Pomarede, et al.  
App. No. : 10/626,217  
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PRIOR TO DEPOSITION  
Examiner : Christy L. Novacek  
Group Art Unit : 2822  
Customer No. : 20,995

Confirmation Number: 9650

Commissioner for Patents  
Post Office Box 1450  
Alexandria, Virginia 22313-1450

**DECLARATION OF PRIOR INVENTION IN THE UNITED STATES OF AMERICA TO  
OVERCOME CITED PATENT OR PUBLICATION UNDER 37 C.F.R. § 1.131**

Sir:

I, Eric J. Shero, do hereby declare as follows:

1. I am a named joint inventor of the subject matter of U.S. Patent Application 10/626,217 (filed 24 July 2003), which is a divisional of U.S. Patent Application 09/944,734 (filed 31 August 2001), which claims the benefit of U.S. Provisional Applications 60/253,693 (filed 24 November 2000) and 60/283,584 (filed 13 April 2001).
2. The joint inventors who contributed to the development of the presently claimed invention are Christophe F. Pomarede, Jeff Roberts and Eric J. Shero.
3. I have read the Final Office Action dated 17 December 2004, and understand that Claims 1-3, 9-11 and 15 have been rejected by the Examiner under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent 6,800,830 ("Mahawili").

Application Number 10/626,217

4. I further understand that Claims 4-8 and 12-14 stand rejected as being obvious based on Mahawili in view of one or more of U.S. Patent 6,727,148 ("Setton"), U.S. Patent 6,297,539 ("Ma") and U.S. Patent 6,744,104 ("Aoki").
5. I conceived of the subject matter of the present application before 18 August 2000 and, therefore, before the earliest priority date to which Mahawili may be entitled.
6. Exhibit A is a photocopy of an invention disclosure that describes the invention claimed in the present application. All three joint inventors signed the invention disclosure before 18 August 2000.
7. Following conception, I assisted patent attorneys with the preparation of a provisional patent application related to the invention. From a date before 18 August 2000 until filing of a provisional patent application on 24 November 2000, I worked diligently with the patent attorneys to prepare the application and to ensure that it accurately represented the invention.
8. All work described herein was performed by me or one of the other joint inventors, or on our behalf, in the United States of America.
9. All statements made herein of my own knowledge are true. All statements made on information and belief are believed to be true. These statements were made with the knowledge that willful false statements and the like so made are punishable by fine, imprisonment, or both, under 18 U.S.C. § 1001, and that such willful false statements may jeopardize the validity of the application or any patent issuing therefrom.

1/14/05

Date

  
Eric J. Shero

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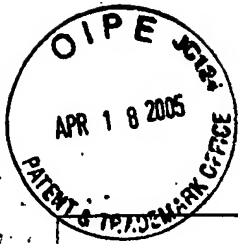


EXHIBIT A

ASMEX-284A

Accepted ☐ Declined ☐

ASM



Patent Office  
Reference No.: \_\_\_\_\_

Date Forwarded  
to Patent Attorney: \_\_\_\_\_

\_\_\_\_\_  
Patent Committee

CONFIDENTIAL  
**PATENT DISCLOSURE**

We are required to disclose to the U.S. Patent and Trademark Office all information which is material to the examination of a patent application. In addition, under U.S. patent law, an application must be filed within one year of the earliest event which publicizes or commercializes the invention which is the subject of the application. Moreover, in order to preserve the right to obtain foreign patents, a U.S. patent application must be filed before such event occurs.

Therefore, please carefully complete the following questionnaire to provide us with the information necessary to comply with these disclosure requirements. Also, please attach a complete description of the invention in the manner described below so that a patent search may be conducted and a parent application prepared and timely filed. It should be noted that errors and omissions in connection with this information can result in the invalidity or unenforceability of any resultant patent.

Inventors and employees are not authorized to discuss details in this disclosure with anyone outside of ASM.

1. *Title of Invention:* ***A Method to Modify the Surface Termination of Layers Prior to Film Deposition***

2. *Inventor(s):*

*Full Name<sup>1</sup>*

*(including middle initial)*

*Citizenship*

*City, State & Country  
of Residence*

*Postal Address*

Eric J. Shero

U.S

ASM America, Inc.

3440 East University Dr  
Phoenix, AZ 85034-7200

Christophe F. Poméroy

France

ASM America, Inc.

3440 East University Dr  
Phoenix, AZ 85034-7200

Jeff Roberts

U.S

ASM America, Inc.

ASM America, Inc.  
3440 East University Dr  
Phoenix, AZ 85034-7200



<sup>1</sup>Include all persons associated with the making of the invention. Please note that only true inventors, as determined under the technical requirements of the patent law, can be named in a patent application, and that no such inventor should be omitted.

3. Conception of the Invention:

Place(s)

ASMA Harbour Bldg.

Inventive Circumstances<sup>2</sup>

All were discussing poor interface between Silicon and ALCVD zirconia. ES suggested using F or Cl radicals generated by RP source to produce surface moieties that are easily attacked by water to form silanol groups. CP and JR suggested similar measures at high K-poly interface making Si-N or Si-Si surface bonds to promote B diffusion suppression and enhance poly-Si or SiGe nucleation.

<sup>2</sup>Briefly describe the contributions, suggestions, experiments, etc. of each inventor listed above, as well as any other pertinent circumstances surrounding the conception of the invention.

4. Initial drawings or sketches and written description of the invention:

Place(s)

ASMA - University

Circumstances<sup>3</sup>

Excel spreadsheet(s) describing development timeline using RP (remote plasma) generated radicals for surface modification prior to several thin film depositions

<sup>3</sup>Attach copies, if available, or describe the present location of initial drawings, sketches, lab notebooks, description, etc.

5.

*Initial disclosure of the invention to others:*

Place(s)

ASMA - University

Person(s) receiving disclosure

E. Strickland, R. Bergman, M. Jackson, Jim Gutt, Timo Bergman, Chris Werkhoven

Circumstances

Presented Sematech with high K development plan on Phoenix cluster/Pulsar that included using different surface terminations before zirconia ALCVD

6. *Initial tests, uses or operations of the invention:*

Place(s)

Person(s) present

Circumstances<sup>4</sup>

<sup>4</sup>*Describe any changes made as a result of these initial tests, uses or operations.*

7. *What is the closest "prior art"; that is, what devices, technologies, structures, processes, information or materials which existed publicly or privately before the invention was made are considered to be most closely related to the invention? Each person identified in Paragraph 2 should answer this question.*

Date(s)

Place(s)

Person(s) involved

Circumstances<sup>5</sup>

Most closely related are CVD film deposition patents that utilize remote plasma sources to generate radicals to vapor deposit continuous films, i.e greater than one monolayer of material.

No one has specifically (as far as I have seen in a 2 hour search of USPTO database) addressed the utility of using RP excited gases to modify the surface termination of the base layer prior to the deposition of a thin layer of a different material. Especially with respect to an adsorption driven processes such ALD (and MOCVD, CVD and JVD for that matter) or a nucleation sensitive process like poly-Si and SiGe (SiGeC) deposition on dielectric materials.

<sup>5</sup>*Identify and, if possible, attach copies of prior publications, patents, etc. which are most closely related to the invention.*

8. *Other than the initial disclosure described in paragraph 5, has the invention ever been disclosed orally or in writing to any person other than the fellow employees? If so, provide the following information:*

Place(s)

Espoo, Finland

Person(s) receiving disclosure

Suvvi Hauka

Circumstances<sup>6</sup>

ES was asking the question to Dr. Hauka if she believed a F terminated Si surface would be more susceptible to attack by moisture to form the silanol groups that metal chlorides need to chemisorb.

<sup>6</sup>Include any instances of private or public offers to sell the invention, as well as requests for financing, grant applications, demonstrations, theses, abstracts, oral presentations, trade shows, catalogs, etc. Identify all relevant publications, correspondence, etc. and, if possible, attach copies.

9. Has the invention ever been used commercially for any purpose? If so, provide the following information

Date(s)Place(s)Person(s) involvedCircumstances<sup>7</sup>

Not to my knowledge

<sup>7</sup>Include any commercial uses, even if details of the invention were kept secret and not disclosed to the public.

10. Are any disclosures planned for the near future?

Planned Disclosure<sup>8</sup>Approximate DateCircumstances<sup>8</sup>

Depending on results obtained at ASMA, and if they are shared with Sematech, may be presented by Sematech at first opportunity to member companies.

<sup>8</sup>Describe any imminent publication, oral presentation, trade show, offer of sale, or sale of the invention.





11. Identify any identities that sponsored or paid, in whole or in part, for the work that led to the conception or reduction to practice of the invention.

Entity

Nature of Sponsorship

Circumstances<sup>9</sup>

None, conceived before any work had begun with Sematech and they had no involvement on conception

<sup>9</sup>Describe the contribution of any funds, grants, salaries, materials, equipment or facilities provided by any governmental agency, academic or research institution, industrial sponsor, etc.

12. Invention Disclosure:

Describe the invention in the spaces provided below. If necessary to fully describe the invention, attach reports, drawings, written descriptions, shop and lab notebook records, etc. Please note that the patent application based on this invention must be sufficiently detailed so as to "enable" a person of ordinary skill in this technology to make and use the invention, and that is must disclose the "best mode" for carrying out the invention.

- (1) BACKGROUND. Describe the field to which the invention relates and explain what is wrong with the prior art. Provide sufficient background information to enable the reader to clearly appreciate the problems that existed prior to the invention.

The current state of the art in remote, radical assisted processes have targeted the CVD of continuous films, i.e. greater than one monolayer of material. No one has specifically (as far as I have seen with a very limited search) addressed the utility of using RP excited gases to change the surface termination prior to an adsorption driven and sensitive processes such ALD or nucleation sensitive process like poly on high K.

What is needed is a low temperature method to simply change the surface termination between thin layers, without *depositing* a film of significant thickness or *modifying its bulk composition*. Either of these paths could adversely effect the behavior of the stacked structure.

By changing the surface termination, one can "kick-start" the chemisorption process of certain precursors on materials (such as, but not limited to) silicon. This will



accelerate the ALD process or make it entirely possible. This is similar to what people have done using wet chemistries, i.e. changing the surface termination of a wafer from -O to -H, so that silicon can be epitaxially grown. A remote plasma is simply another mechanism to accomplish a change in surface termination.

The novelty and invention is to use a remote plasma source (or an in-situ plasma), in a cluster tool environment, to allow the grafting of atoms or groups onto a surface that normally may require high temperature in order to achieve the necessary energy to break the existing surface bonds. The process should be clustered to avoid desorbing or contaminating the surface species before the next process step which is surface sensitive like ALCVD or CVD. The process will be tuned such that the remote plasma source imparts the necessary activation energy to break the surface bonds and form new ones, while the temperature is maintained low enough to prevent etching of the substrate or significant diffusion of the active species into the "bulk".

- (2) DESCRIPTION. Write a detailed description of the invention, referencing sketches, drawings or photographs. Describe the best way to carry out the invention

Utilize Remote Plasma (RP) or in-situ plasma sources to excite gases which react with the surface atoms of a film to *change its surface termination* before deposition of the next thin film in a multi-layered stack structure. Relevant sample structures include CMOS gate stacks, DRAM capacitors, and floating gate transistors to name a few.

Modification of the surface terminating groups with radical moieties prior to next layer deposition has direct application in permitting, promoting or accelerating the chemisorption of atomic layer deposition (ALD), MOCVD and CVD precursors. Furthermore, changing the surface termination between layers can promote layer adhesion or nucleation specifically in the area of poly or metal gates on high K materials. By making an interface more like the material of the next film, unfavorable surface free energy changes can be overcome.

- (3) ADVANTAGES. List and explain the advantages of the invention in the order of their importance, and describe how the invention solves or overcomes the problems of the prior art. Include all possible uses and modifications of the invention. Speculate reasonably on any additional uses that the invention may have, either by itself or in combination with other known or as yet unknown technologies.

1. Accelerates or promotes chemisorption of ALD, MOCVD, or CVD precursors onto substrates by increasing or changing surface reactivity. Currently,

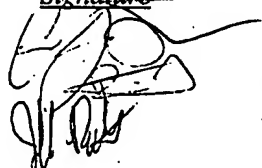


practitioners of these deposition schemes do not attempt to singly modify the surface termination prior to the initial reactant exposure of the wafer, *using plasma processes*. The advantage of plasma processes is specific engineering of the surface termination through precursor selection, plasma power and frequency, and temperature.

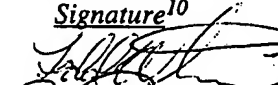

2. Changing the surface termination via remote plasma or in-situ plasma processing can insert a single monolayer of atoms at the surface of a layer to act as an adhesion promoter or diffusion barrier without affecting the bulk properties of the thin films.
3. A low temperature method that is compatible with the current temperature range utilized in ALD reactors, thus allowing integration into existing reactor designs.

13. I (we) verify that the foregoing is true and correct.

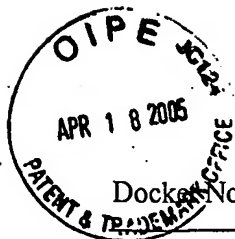
Inventor(s):

<u>Signature<sup>10</sup></u>	<u>Printed name</u>
	Eric Sheru
	Christophe PENAARDE
	Jeff Roberts

Witnessed and Understood (two or more witnesses should sign):

<u>Signature<sup>10</sup></u>	<u>Printed name</u>
	Ted Westerman
	ROBERT PAQUIAO

<sup>10</sup>All inventors and witnesses should initial and date each page of the attachments.



Docket No.: ASMEX.284DV1

Customer No. 20,995

### INFORMATION DISCLOSURE STATEMENT

Applicant : Pomarede, et al.  
App. No : 10/626,217  
Filed : July 24, 2003  
For : SURFACE PREPARATION PRIOR TO DEPOSITION  
Examiner : Christy L. Novacek  
Art Unit : 2822

Mail Stop Amendment  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

Enclosed for filing in the above-identified application is an Information Disclosure Statement by Applicant (PTO/SB/08 equivalent) listing 2 references to be considered by the Examiner. This Information Disclosure Statement is being filed after the mailing date of a final action or after the mailing date of a Notice of Allowance. This Statement is accompanied by the fee set forth in 37 C.F.R. § 1.17(p). The Commissioner is hereby authorized to charge any additional fees which may be required or to credit any overpayment to Account No. 11-1410.

#### CERTIFICATION UNDER 37 C.F.R. § 1.97(e)(2)

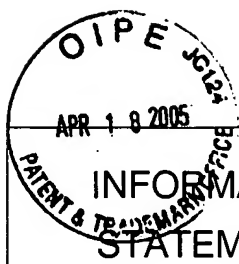
I hereby certify that no item of information contained in this Statement was cited in a communication from a foreign Patent Office in a counterpart foreign application, and, to my knowledge after making reasonable inquiry, was known to any individual designated in 37 C.F.R. § 1.56(c) more than 3 months prior to the filing of this Information Disclosure Statement.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: 21 Jan 05

By: Kyle F. Schlueter  
Kyle F. Schlueter, Registration No. 54,912  
Attorney of Record  
Customer No. 20,995  
(949) 760-0404



<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>	Application No.	ASMEX.284DV1
	Filing Date	July 24, 2003
	First Named Inventor	Pomarede, et al.
	Art Unit	2822
(Multiple sheets used when necessary)	Examiner	Christy L. Novacek
SHEET 1 OF 1	Attorney Docket No.	ASMEX.284DV1

### U.S. PATENT DOCUMENTS

Examiner Initials	Cite No.	Document Number Number - Kind Code (if known) Example: 1,234,567 B1	Publication Date MM-DD-YYYY	Name of Patentee or Applicant	Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear
		6,503,330	1/7/03	Sneh, et al.	
		6,551,399	4/22/03	Sneh, et al.	

### FOREIGN PATENT DOCUMENTS

Examiner Initials	Cite No.	Foreign Patent Document Country Code-Number-Kind Code Example: JP 1234567 A1	Publication Date MM-DD-YYYY	Name of Patentee or Applicant	Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear	T <sup>1</sup>

### NON PATENT LITERATURE DOCUMENTS

Examiner Initials	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T <sup>1</sup>

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Examiner Signature	Date Considered
<b>*Examiner:</b> Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.	

T<sup>1</sup> - Place a check mark in this area when an English language Translation is attached.

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